University of Saskatchewan
Department of Physics and Engineering Physics
PHYS 229.3 Introductory Electromagnetism and AC Circuits
Mid-term Exam 24 February, 2005

Time: 80 minutes

Closed book examination. Answer all five (5) questions clearly showing your work. All questions are of equal value. A formula sheet is attached.

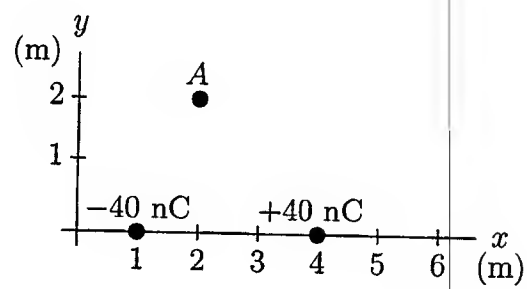
1. An electric dipole consists of a -40.0×10^{-9} C charge at position (1.00, 0.00) m and a $+40.0 \times 10^{-9}$ C charge at position (4.00, 0.00) m.

   (a) Determine the magnitude and direction of the electric field at point A which is located at (2.00, 2.00) m.

   (b) If an α-particle ($^4_2\mathrm{He}^{++}$) is released from rest at the point (3.00, 0.00) m, after it travels a distance of 1.00 m what are its:

   i. position, and

   ii. speed.



2. A hollow conducting sphere is surrounded by a larger concentric spherical conducting shell. The inner sphere has charge $-2Q$ and the outer shell has net charge $+5Q$. The charges are in electrostatic equilibrium. Find the electric fields everywhere.

3. At an altitude of 300-km in the F-region of the Earth's ionosphere there are free charged particles in the form of ions and electrons. At high-latitudes such as Saskatoon, the Earth's magnetic field is directed almost vertically downward and these charged particles will gyrate about the magnetic field rarely colliding with other particles in the process. Under these conditions, if an electron is moving perpendicular to the Earth's magnetic field it takes 0.670 μs to complete one revolution. Determine the magnitude of the Earth's magnetic field at an altitude of 300-km above Saskatoon.

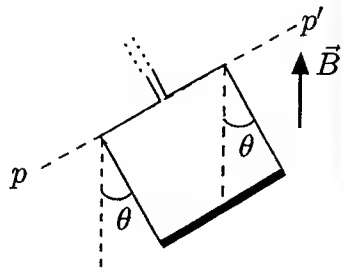
T=

continued on page 2 ...

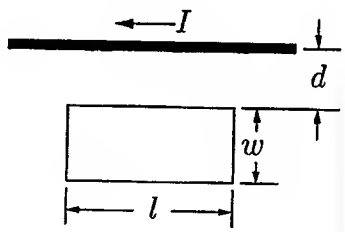
4. A copper rod of mass 5.00 g and length 0.300 m is suspended by two copper wires of negligible mass and 1.00 m length in a magnetic field $B = 0.400$ T directed vertically upward. The wires and the rod form a complete circuit with a current I and the rod is supported like a *swing* as shown.

   (a) Determine the direction of the current and the magnitude of I such that the swing is in equilibrium for $\theta = 30.0°$.

   (b) What value of θ gives the maximum torque (moment) about the pp'-axis due to the magnetic force?



5. A rectangular loop of width w and length l is located near a long wire carrying a current I as shown. The wire is parallel to the long side of the loop and separated by a distance d. Find the total magnetic flux through the loop due to the current in the wire.



END OF EXAM